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# EGG PLACING BY DIBRACHYS BOUCHEANUS RATZEBURG.

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While studying the hymenopterous parasites associated with *Samia cecropia* Linnaeus in the Chicago area (described by Marsh,* '34), the writer had an unusual opportunity of observing the egg-laying technique of the cosmopolitan chalcid *Dibrachys boucheanus* Ratzeburg. This occasion is taken to describe in some detail the actual placing of the eggs.

In the series of parasites studied, *D. boucheanus* most commonly occurred as a secondary parasite on the ichneumonid *Spilocryptus extrematis* Cresson. The most pupae of this chalcid found on one larva of *S. extrematis* was 53, while an average of 12 occurred in the hundreds of cases of parasitism studied.

In order to observe the actual placing of the eggs by *D. boucheanus* a test tube was divided longitudinally into upper and lower compartments by pushing a strip of light, rather stiff paper down into the tube. Mature hibernating larvae of *S. extrematis* were then removed from their cocoons and placed in the upper compartment while the chalcid female was liberated in the lower. With this set-up the placing of the eggs by the female after she had thrust her ovipositor up through the paper could be closely watched through a hand lens.

The ovipositor is essentially a tube formed by the first pair of valvulae inside which is a lancet composed of the second pair of valvulae. Both structures are not only capable of considerable extension and retraction because of the muscle arrangement at their bases, but are also very pliable and may be bent laterally at right angles at any point at will. The sense of touch appears to be highly developed in these genitalia. When at rest the ovipositor is about 1.5 mm. long but may be extended to twice that length.

The chalcid, after carefully palpating the area beneath a host larva with her antennae tips, would thrust her ovipositor through the paper close beside the larva. After exploring a limited area of the surface of the host larva with the lancet the latter was drawn down into the tube until only the tip protruded. This position was maintained for nearly a minute while an egg was traveling down the tube alongside the rapidly, longitudinally vibrating lancet. The egg is evidently forced downward by contractions of the tube and by the rhythmic motions of the lancet. Finally the tip of the egg appears at the end of the tube and the entire egg suddenly, as if under considerable pressure, bulges out into its normal club shape.

The egg is surprisingly large in comparison with the ovipositor or even with the adult, (the adult female averages slightly less than 3 mm in length), measuring about 0.5 x 0.15 mm. When freshly obtruded it is slightly adhesive

*Marsh, F. L. 1934. "A Regional Study of *Samia cecropia* and Nine Associated Parasites and Hyperparasites." A Master's thesis. Northwestern University Library, Evanston, Illinois.

and sticks to the side of the tip of the lancet and is pushed by the latter down along the side of the host and left adhering lightly to the cuticle of the host. The lancet is then drawn back into the tube and another egg expelled and placed. This continues until eight eggs, more or less, have been bunched on the host. Then the ovipositor is turned at right angles to the surface of the host and a puncture made by the rapidly vibrating lancet. The end of the tube also enters the host's body and the entire ovipositor is bent from side to side as the fat bodies and other internal structures are palpated by the lancet tip.

The ovipositor is then withdrawn and usually a second cluster of six or eight eggs is placed, followed by a second puncture and exploration of the interior. This latter act accomplishes the distribution of the poison from the end of the lancet which causes the slow death and partial preservation of the host larva or pupa. Not infrequently eggs already placed were punctured by the lancet as another egg was added. The ovipositor is now withdrawn from the cocoon and a new station taken at another point on the same cocoon or the female may move to another cocoon. Other females have been observed to palpate over freshly laid eggs and immediately add a cluster of their own beside those already present.

The female of *D. boucheanus* is not at all specific in her choice of host. The writer found that females would oviposit on any small larva which was placed inside a thin silk cocoon. Some females even placed their eggs in cotton and paper. Larvae with thickened cuticle such as those of the tachina fly *Winthemia datanae* Tns. were impervious to puncture by the ovipositor and chalcid larvae always starved when the eggs were laid on such larvae which had been placed in small cocoons. This lack of specificity in host selection explains the cosmopolitan nature of this chalcid.

In addition to this impartiality as regards host selection the great reproductive capacity of this chalcid also serves markedly in its importance as a parasite. It is not at all unusual for one female to lay 400 eggs. Females kept in subdued light and in a temperature of 75° F, and fed on dilute honey continued to oviposit for 50 days. When crowded by higher temperatures and sunshine 19 generations were completed in twelve months. The only natural food that *D. boucheanus* was observed to take was the sap of box elder trees.

## A CRITICAL REVIEW OF THE TREATMENT OF NORTH AMERICAN PARNASSIUS SPECIES BY FELIX BRYK IN DAS TIERREICH, PART 65*.

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A monograph of the lepidopterous genus *Parnassius* has recently appeared as Part 65 of that monumental undertaking "Das Tierreich." The volume in question comprises nearly 800 closely printed pages and 698 illustrations. The author, Felix Bryk of the Zoological Museum of Berlin, Germany, has long posed as a specialist in this genus of butterflies and is the editor of a publication,

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"Parnassiana."

In the present article the intention is not to review the entire work, but merely to present a critical resumé of Bryk's treatment of our North American *Parnassius* species; this is all the more necessary owing to the peculiar system of nomenclature adopted, and the fact that this portion of the work is most unfortunately full of errors, due to carelessness in verifying original descriptions, lack of knowledge of our North American literature and misidentifications of existing names.

The author's ideas on nomenclature, racial forms, etc. are well expressed in the introduction to an article by himself and Curt Eisner in Parnassiana, Vol. I, Pts. 7/8, p. 11, 1931, entitled "Kritische Revision der Gattung *Parnassius*" which is the foundation for the more extended monograph in "Das Tierreich." According to this introduction the naming of all the slight aberrational forms which so frequently occur in this group is advocated, the authors proposing to use *"nomina collectiva"* for this purpose, although frankly admitting that they fall outside the International Rules of Nomenclature. These form-names are based on such minor differences as the lacking of a black spot, the pupilling of a spot with red, the centering of a red spot with white, and so on, *ad infinitum,* the same form-name being applicable in any one of the various geographical races for a similar variation of pattern. Not only this but form-names can apparently be combined by the use of a plus sign and we are treated to such nomenclatorial atrocities as *primo* + *tertiopicta* + *ornata* (Parn. II, 97) for a certain combination of red color in the normally black spots of *P. clodius* var. *baldur*. Such a combination drives the poor catalogue-maker to distraction and causes wonderment as to whether the aberration is in the wing-pattern of the butterfly or the minds of the authors.

Having exhausted doubtless both themselves and the possible, or impossible, form-names the authors then turn to geographical races. Their expressed views as to races in the introduction mentioned above are sound enough but, alas, their nomenclatorial actions, as far at least as our North American species are concerned, run in many instances quite contrary to these views. They maintain, for instance, that to get the proper appearance of a race, one should have long series from a given locality, extending, where possible, over a period of several years. On reading such a sound statement one is inclined to cry "hurrah," and wish that all namers of races were similarly-minded; however on finding that a new race of *clodius* with the very suitable name *incredibilis* has been based on a *single* male from Mt. St. Elias, Alaska in the British Museum, one realizes that once again the itch to create a new name has got the better of the good intentions. Other examples are not infrequent of this urge to create racial names based on small lots of specimens from isolated localities; some of these are unrecognizable as they have obviously been misspelled by the authors, an unfortunate feature which will give our American entomologists considerable trouble. Then too the authors have shown little knowledge of the topography of the western States and Canadian provinces and the nature of the faunal zones; to anyone who has actually collected *Parnassius* extensively in the West (as has the writer) the localities cited under the individual racial headings not infrequently appear quite impossible to vizualise

as harboring a single race, in the generally accepted sense.

It is to be hoped that more accuracy has been displayed in the treatment of the European and Asiatic species; otherwise the value of the work from the scientific standpoint will be considerably reduced.

A detailed analysis of the arrangement of our North American species follows:—

*P. eversmanni thor* Hy. Edw. This North American race is credited to W. H. Edwards, the author being apparently quite unaware that W. H. Edwards and Hy. Edwards were two distinct persons; the mistake occurs throughout the work. The form-name *quincunx* Br. & Ei. (1934, Parn. III, 15) is applied to a specimen from Slate Creek, Alaska with reduced discal spot; the name has already been used for a form of *smintheus* and apparently becomes a homonym, but in any case could be advantageously sunk in the synonymy of *thor*. Form *desubmarginata* Br. & Ei. (1934, Parn. III, 32) from Alaska is figured (fig. 135); it represents a male form with much reduced submarginal and marginal dark bands and the name may stand as a form. Ab. *kohlsaati* Gund. (1932, Pan Pac. Ent. VIII, 123) with yellow eye-spots instead of red ones, is sunk in the interests of uniformity of nomenclature (!!) to *ochreoocellata* Br. & Ei., a name originally based on a form of one of the Asiatic races; this synonymy should be disregarded.

*P. clodius* Men. Eight male and three female forms, based on specimens of this species, are first discussed, but in the treatment of the following seven subspecies or geographical races numerous other form-names and combinations are introduced (*vide* 1932, Parn. II, pp. 96/99), a discussion of which can profitably be omitted.

The first form-name, *flavoocellata* Bryk, is proposed to supercede *altaurus* Dyar, again presumably in the interests (?) of uniformity. The author cites as reference Bull. 52, U. S. N. M. with the incorrect locality "Wyoming" and has overlooked Dyar's more detailed statement (1902, Proc. Ent. Soc. Wash. V, 290) where the locality is correctly given as Alturas Lake, Idaho, a small lake in the Sawtooth Range of the south-central portion of the state. The citation "Wright, Butt. W. Coast 75, Pl. 1, f. 3, b" should have been omitted; the specimens figured are from "Eastern Base Sierra Nevadas" and "Vancouver Is." and have little to do either with each other or with *altaurus*. Finally no mention is made of Gunder's statement (1932, Pan Pac. Ent. VIII, 124) that in a long series of practically topotypical specimens the yellow color of the ocelli was constant and that therefore the name should be given racial status. While the fading of the red color in the ocelli to a dull yellowish is frequently found in old, worn specimens, there is no reason to suppose that all of Gunder's material consisted of such specimens; his contention therefore should be followed. It might be added that through the courtesy of the authorities of the U. S. National Museum a pair from the type material of *altaurus* has been examined. The race is a heavily marked one of the *claudianus* type and apart from the yellowish color of the ocelli is practically identical both in size and maculation with a series from the Yellowstone Park, Wyo., in the Canadian National Collection, one of which actually does show yellowish ocelli. These specimens are referred to later under *gallatinus*. Holland's

figure of *altaurus* (1931, Rev. Ed. Butt. Book, Pl. LXIX, fig. 11) is quite erroneous.

Form *casta* Bryk, with missing anal spot, has already been correctly relegated to the synonymy of *clodius* by Barnes and Benjamin in their 1926 Check List.

Forms *lorquini* Obert. and *immaculata* Skin., next treated, are well-known to American entomologists. The former may stay as placed in the 1926 List as an aberration of *baldur,* but the latter, based on a specimen from Yellowstone Park, Wyo. would probably be better placed as an aberration of the race *gallatinus* Stich. from an adjacent locality in Montana. It might be noted that Bryk's reference to *immaculata* Skin. as 1909, Ent. News, XXII, 3, is wrong; it should be, 1911, Ent. News, XXII, 108, and the locality is not "California" but as above cited. This apparent lack of verification of original descriptions is one of the most serious faults of the work.

Form *binigrimaculella* Gund. with ocelli reduced to small black spots is retained without change, although Gunder himself proposes (1932, Pan Pac. Ent. VIII, 124) to relegate it to the synonymy.

The next following, form *menetriesi,* shows an incomprehensible muddle. Firstly for some unknown reason the name is credited to Wright, following which the 1877 reference is correctly given, except that W. H. Edwards instead of Hy. Edwards is again cited. The citation to Holland's Butterfly Book, Plate XXXIX, figs 3-6 cannot belong here as the figures are obviously of a *smintheus* form. No mention is made of Skinner's article in Ent. News, XXVII, 210/216, Pl. XII, fig. 3 and the very definite restriction of the name in a racial sense by Barnes and McDunnough (1918, Contributions Nat. Hist. N. Am. Lep. IV, 61/2) has been entirely disregarded. The correct treatment of this name offers certain difficulties; apparently two races were mixed up in the original type series, *viz.* specimens from the Lake Tahoe, Calif. region, to which W. H. Edwards almost immediately applied the name *baldur,* and a female from Utah to which the name was restricted by Barnes and McDunnough. Strictly speaking, if Skinner's suggestion (*op. cit.* p. 216) be followed and the type restricted to the male from Truckee, Calif. (incidentally a locality not cited in the original description) the name *menetriesi* would have priority over *baldur* W. H. Edw. However it might be well argued that, in proposing the name *baldur,* W. H. Edwards definitely restricted *menetriesi* to the Utah specimen and this line of reasoning appears the most satisfactory as both names are thus preserved. *Menetriesi* was used in this racial sense in the 1926 Check List and apparently takes priority over *sol* Br. & Ei.

Form *medionigroocellata* Bryk is a new name proposed to replace *lusca* Stich., with rear ocellus reduced to a black point. It can fall as a synonym of *baldur.*

The male form *extinctoanalis* Br. & Ei. from "California" with missing anal spot on hindwings and the female form *nigroanalis* without red in the same spot from "Sierra Nevada" cited as a form of *sol,* can very satisfactorily be placed in the synonymy of *menetriesi.*

The two final female forms, the celebrated *primo et tertiopicta et ornata* Br. & Ei., already mentioned, and the form *albocentrata* Br. & Ei., with white-

centred ocelli, fall to *baldur;* the first mentioned should scarcely be considered as a valid name.

Following the discussion of the above-mentioned forms the author now turns to the various races. The typical race *clodius clodius* is well figured although the hindwings show rather more submarginal black markings than usual; the range is correctly given as California and Oregon. It should be noted that throughout no reference either to Comstock's Butterflies of California nor to Holland's Revised Edition of the Butterfly Book is given.

*Clodius baldur* Edw. is also correctly treated as an altitude form and figured, but the range of the race has been extended far too much; besides localities in the Sierra Nevada Mts. which are correct and represent the true home of the race, the author adds Mt. Nebo and Salt Lake in Utah and Jackson Hole in Wyoming. The Utah localities are probably merely copied from W. H. Edwards and should be referred to *clodius menetriesi* Hy. Edw. as stated previously; the specimens from Wyoming, in the heart of the Teton Range, belong to *clodius gallatinus* Stich. which extends through southern Montana into Wyoming; Dr. A. B. Klots, who has good series collected by himself at Jackson Hole has kindly furnished this information.

*Clodius sol* Br. & Ei., the type of which is figured, seems best placed as a synonym of *menetriesi* Hy. Edw. The name is based on a small series from "Nevada," with no further locality data, 3 males from Gunnison, Colo. and a pair of specimens from the Teton Mts., Wyoming. Even the authors, in the original description, confess to some doubts in bringing together under one name such a miscellaneous assortment and naively state that they cannot separate further with the material before them, which is perhaps just as well. On the face of it it seems rather strange that specimens from Jackson Hole, Wyo. are assigned to *clodius baldur* whilst those from the Teton Mts. Wyo. are placed in *clodius sol,* although the localities are practically identical. It would certainly be advisable to restrict the name to the "Nevada" types and even this vague locality will afford collectors quite sufficient trouble.

*Clodius claudianus* Stich., originally described from Washington State and the types figured (judging by the note in the original description) on Plate XVII, C of Seitz, Macrolepidoptera of the World, is only listed as from Goldstream, Vancouver Is. The association of the name with the large, strikingly marked race found commonly all along the east coast of Vancouver Is. and in the adjacent State of Washington at low (practically sea) levels is correct. It might, however, be pointed out that in a previous paper (1913, Arch. f. Naturg. Vol. 79, Abt. A (3) p. 3) the author limits the name *claudianus* to material from Washington State, withdraws the reference to Verity's figures of British Columbia specimens (Rhop. Pal. XXII, figs. 17-19), actually cited by Stichel under this name, as being impossibly referable to this race (man kann ihn unmöglich zu *claudianus* ziehen), and refers them to his new race, *pseudogallatinus,* described on the same page and primarily based on material from Yale, B. C. This town is situated at the southern end of the Fraser Canyon at an altitude of only 223 feet above sea-level and no material from the exact locality has been examined; however, there

are long series in the Canadian National Collection from several nearby localities in the Lower Fraser Valley, (where it is quite common at times) from N. Vancouver (slopes of Grouse Mt.) and from Brackendale on the Squamish river, which can only be differentiated from Vancouver Is. material by their slightly smaller size, and even this is variable. *Pseudogallatinus,* still treated in the present work as a race, is figured (fig. 158) and this figure can be well-matched by some of the Fraser Valley specimens. That the author's ideas on the subject are very vacillating and vague may be noted by referring to a further paper by Bryk and Eisner (1932, Parn. II, 98) where *pseudogallatinus* is asserted to be an altitude-form (!) of *claudianus* and the locality citations actually include Wellington, a town at sea level on Vancouver Is., where only *claudianus* flies; in the present monograph, too, Duncan, another Vancouver Is. town, is listed among the localities for *pseudogallatinus.* There appears to be only one well-marked race of *clodius* at moderate altitudes in British Columbia and the sinking of *pseudogallatinus* to *claudianus* in the 1926 Check List was correct; for those wishing a name for the smaller form occurring at much higher altitudes (4-6000 ft.) in the mountains of the south-central section of British Columbia and apparently unknown to Bryk, *gallatinus* Stich. may be used, as has been actually suggested (1927, Can. Ent. LIX, 153).

*Clodius gallatinus* Stich. was apparently unknown to the author; the name was based on a figure in Elrod's Butterflies of Montana of a specimen from Gallatin Co. in which the discocellular spots were connected with the spot on inner margin by a dark band. This race is not well-differentiated, except in the color of the ocelli, from *clodius altaurus.* A series in the Canadian National Collection from Yellowstone Park, Wyo. shows considerable range of variation as regards the above mentioned connecting band, as was to be expected; some male specimens match Elrod's figure excellently and the series obviously should be placed under this name which may be used in *sensu strict.* for the form from southern Montana and the adjacent portions of Wyoming.

*Clodius incredibilis* Bryk is based, as already noted, on a single male from Mt. St. Elias, Alaska. It would appear, from the description, to be a slight modification of *clodius pseudogallatinus* but without material nothing can be said on the subject.

Turning to *P. smintheus* Dbldy. and Hew. a large increase in the number of forms and races is noted, corresponding to the much more extended geographical distribution. *Smintheus,* following the usual European custom, is considered to be a race of the palaearctic *phoebus* Fabr., and probably correctly so, but from the standpoint of North American cataloguers there is no particular reason why it should not remain as a good species in our lists. Ten pages are devoted to the various forms of *phoebus* and according to the author's system of nomenclature all such form-names might be applicable and in certain cases are applied to our American races. However the present discussion will be limited to those form-names actually based on North American material; most of these have already found place in the 1926 Check List. We have *quincunx* Bryk from Colorado with reduced discal spot on primaries; *fermata* Bryk from Denver, Colo. with extra

black spot near base of primaries; both of these will probably fall to *hermodur* Hy. Edw.

*Mariae* Bryk from "N. America" with obsolete subcostal ocellus can safely be sunk for the present under the typical race. *Minuscula* Bryk, also with the edifying locality "N. America," is based on a dwarf form for which there are already several valid names. *Melanophora* Bryk from Denver, Colo. with no red in the basal spots has been correctly sunk to *hermodur* in the Check List, and the quite recently described *ernestinae* Br. & Eis. (1935. Parn. III, 51) from Ptarmigan Pass in the Canadian Rockies with reduced black spot in cell of primaries will fall to *smintheus*. *Ocellata* Bryk and *nigricans* Bryk, included in the Check List, should be omitted, the former being credited to Verity from unknown locality but probably European, the latter based primarily on Swiss material.

In dealing with the racial forms of *smintheus* it is necessary to take into consideration a paper by Bryk and Eisner (1935, Parn. III, 51) which evidently appeared after the main section of the volume was in press and it might be well to quote in part a statement in this article which throws considerable light on the racial concepts of these authors. Writing of *smintheus* they state that the species cannot be split into races by mere consideration of geographical distribution; they have been forced, after very careful study, to lay the greatest stress on *similarity of habitus* and in consequence to *place variants from a single locality in different races.* Such a radical procedure will scarcely find favor with the majority of systematists, upsetting as it does our whole idea of what constitutes a race, but it does explain quite satisfactorily the peculiar distributional records given and which have already been commented on under *clodius*. Most workers, however, will undoubtedly agree as to the difficulty in splitting *smintheus* into very definite races and at once the question arises, Why try?

As in *clodius* the literature references give no citations of Comstock's Butterflies of California or the Revised Edition of Holland's Butterfly Book. The treatment of the species in its better known distributional areas follows largely the lines of the 1926 Check List; Fruhstorfer's various names as well as *utahensis* Roth. have been raised to racial status but these can well remain synonyms as treated in the list; the author had apparently no material before him at the time and in the later paper (*op. cit.* p. 56) both *aristion* Fruhs. and *sordellus* Fruhs. are relegated to the synonymy; *catullius* however is held distinct on the strength of considerable material from Coloradan localities (including topotypical specimens from Pikes Peak) and stated to be close to *utahensis*, but from the text it would almost appear that the name was used in the sense of *sayii* Edw. of the check list. Study of a long series of Colorado material kindly loaned by F. Martin Brown of Colorado Springs and including specimens from all over the state confirm the opinion already expressed (1916, B. & McD. Contr. III, 55) that further splitting into so-called races is most inadvisable.

Typical *smintheus* from the Canadian Rockies is well figured (Fig. 230) in the male sex, the specimen being rather larger than Laggan specimens, but fitting in well with a long series from Waterton, Alta. in our collection. *Nanus* Neum. and *mendica* Stich. (*minor* Verity) are not specially treated, the names be-

ing merely included in the list of citations. In this connection a slight correction of a statement made in the Canadian Entomologist (1927, Vol. LIX, 153) might be in order; in this article it was claimed that the specimens in the type series of *nanus* from Spence's Bridge, B. C. were taken in high altitudes in the near-by mountains and could not have occurred in the dry valley. However, in conversation with an old resident of Lillooet (about 40 miles as the crow flies from Spence's Bridge), it was ascertained that 30 or more years ago, small specimens of *smintheus* did undoubtedly fly at low levels just above the town of Lillooet but had not been seen for years; in 1933 a single rather small female was actually secured, quite freshly emerged, by myself about 100 feet above Seton Lake, no other specimens being seen, and further a short series of similarly small specimens was supplied by the above mentioned collector from a point on the Fraser river about 30 miles north of Lillooet. It would seem, therefore, that a stunted race or form may occur spasmodically in the hot, dry valleys of the Fraser region and that, if restricted to the Spence's Bridge material, the name *nanus* could be applicable to such a form. More intensive collecting in the region will, however, be necessary to decide the question. On Mt. McLean itself in 1933, a very cold year, *smintheus* was common on a steep slope at between 4000-5000 ft. altitude but none were seen at the higher levels above tree-line as in 1926 (Can Ent. *op. cit.* 153); the specimens were quite large and tending toward *magnus* Wgt.

*Smintheus hermodur* Hy. Edw., wrongly ascribed to W. H. Edwards, is treated as a race from S. Colorado rather than an altitude-form, and *magnus* Wgt. is applied in the usual way to the large race from low altitudes in south-central British Columbia. *Smintheus sayii* Edw. is wrongly restricted to Montana specimens and in the later paper (p. 54) the type locality is definitely stated to be the Judith Mts., Montana and not Colorado. This inexcusable error can only be ascribed to carelessness on the part of the author in verifying original descriptions. Edwards based his description on a female from Pikes Peak, Colorado in the Collection of the American Entomological Society of Philadelphia, as is very definitely stated (1863, Proc. Ent. Soc. Phil. II, 78); this type is lost but the name was used, on the strength of the original measurements given for the type, for the Coloradan form of lower altitudes (1916, B. & McD. Contributions III (2) 55/6) or so-called warm peaks and this usage seems correct. Long series from Teller Co. in the Martin Brown Collection have been examined and are considered topotypical. The Montana locality is probably a perpetuation of Stichel's error in his *Parnassius* Revision (1907, Gen. Insect. 58, 20) which is possibly based on a paper by Edwards (1883, Pap. III, 157) dealing with *Parnassius* captured in the Judith Mts. some of which seem to have found their way to the British Museum, but this material cannot possibly be regarded as constituting the types of *sayii* nor can Holland's figures of the so-called types (1931, Rev. Ed. Butt. Book, Pl. LXIX, figs. 12, 13) be correct. The figures given of the false *sayii* match well with specimens of *magnus* in the Canadian National Collection.

*Smintheus behrii* Edw. is described as a large subspecies close to *magnus* and has evidently been entirely misidentified. As a matter of fact *behrii* is a small and rather rare race from the higher Sierra Nevadas of California and is well illustrat-

ed by Edwards in his Butterflies of North America (Vol. I, Parn. Pl. III, fig. 3) and in Comstock's Butterflies of California (Pl. VI, figs. 1-3). Stichel's figure in Seitz, Macrolepidoptera of the World (Vol. V, Pl. XVII,d which was evidently the basis for the author's determination, is incorrect.

Four recently described subspecies, not included in the Check List, are treated in the supplement to the main volume.

*Smintheus idahoensis* Br. & Ei. (1931, Parn. I, 5, figs. 4/5) from Wallace, Idaho is diagnosed and figured (fig. 231). It is characterized by the great reduction of black basal shading on both wings and is figured by Comstock as *niger* Wgt. (Butt. Calif. Pl. VI. fig. 4). Correspondence elicits the fact that this feature is by no means constant even in Wallace specimens; the name, therefore, should be treated as a "form" rather than a race as in all other respects it can be excellently matched by specimens in the Canadian National Collection from Waterton Lakes, Alta.

*Smintheus hollandi* Br. & Ei. (1935, Parn. III, 53) is cited as from "La Sal Mts., Turpus Valley, Calif." Dr. J. Comstock of the Los Angeles Museum, who was consulted in the matter, states positively that no such locality exists in the state and correspondence with the American Geographical Society elicits the fact that the only La Sal Mts. known to them are on the borders of Utah and Colorado. The "race" is characterized as "Very striking, moderately large, very strongly white-scaled, richly marked, with white-fringed border in both sexes. Cell-spot on forewing very strong, spot above inner margin and anal-spot well developed" and the female figured (fig. 230a) as *smintheus*. Judging by this figure the best way to dispose of the name would be to sink it as a synonym of *sayii* Edw.

*Smintheus montanulus* Br. & Ei. (1935, Parn. III, 55) from "Turah, Montana and Speery Valley." The former locality, according to Dr. A. Avinoff, is about 15 miles east of Missoula, the latter, which should be spelt "Sperry Valley," is in Glacier Park, the material was collected by Dr. W. R. Sweadner. This race is said to be smaller than Montana specimens treated of under *sayii* and forms the transition to *idahoensis*, showing the same reduction of the basal black areas; the length of forewing is given as 29-30 mm. As northern Montana specimens in general are markedly similar to those from southern Alberta, which are considered to be typical *smintheus*, the name *montanulus* can be sunk either to *smintheus* or to 'form' *idahoensis*, the two type localities being very close together.

*Smintheus dakotaensis* Br. & Ei. (1935, Parn. III, 55) is largely based on specimens from the Black Hills, S. Dakota but, as cotypes, specimens from the Big Horn and Teton Mts., Wyoming are included, which would certainly indicate that racial characteristics, as we know them, were not particularly well-defined; through the kindness of Mr. C. F. dos Passos a good series from the type locality has been examined and also other specimens from N. E. Nebraska, kindly sent by Mr. R. E. Leussler of Omaha, Nebraska. There is the usual variability among these specimens and nothing very tangible can be pointed to as separating them from the southern Alberta *smintheus* except a greater tendency to red centres in the spots beyond the cell in the male and a somewhat larger size. With typical *sayii*, as it occurs in the Pikes Peak region or in Estes Park, it is practically identical. As, however, the Black Hills are an isolated range the name may well

hold in a racial sense for specimens from this region but should certainly be definitely restricted to such material.

*Smintheus manitobaensis* Br. & Ei. (1935, Parn. III, 55), ostensibly from Manitoba, has already been dealt with (1936, Can. Ent. LXVIII, 43) and the name falls to *smintheus*. End Mountain, the type locality, is in the vicinity of Exshaw, Alta. and a pair of specimens from this locality are in the Canadian National Collection.

Three races from Alaska are recognized, concerning which little can be said, owing to lack of material; *apricatus* Stich. from Kodiak Is. is figured, *elias* Br. (1934, Parn. III, 31), based on a single male from St. Elias, is also figured and *golovinus* Holl., from the Nome region, is discussed. This latter race is figured in the revised edition of the Butterfly Book (Pl. LXIX, figs. 3, 4).

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## TWO UNRECORDED SPECIES OF SCUTACARIDAE FROM THE SOUTHERN APPALACHIANS.

BY ARTHUR PAUL JACOT,
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The Scutacaridae are very little understood. Paoli[1] divided the genera chiefly on the basis of presence or absence of ungual hooks on tarsi I and IV. This is patently a superficial and non-phylogenic character. Within a genus all grades of reduction of unguis are to be found so that it is quite conceivable that species without unguis may belong to genera with unguis. Furthermore in each genus one may find, if Paoli's figures are correct, species with dorsal segments, ranging in number from four to six. Yet number of transverse plates, usually regarded as an indication of number of somatic segments, is certainly a more fundamental character than ungual reduction. On the other hand it is quite difficult to determine with certainty the total number of transverse plates in some species. My experience leads me to regard the total number of plates as four, each bearing four bristles. At present this character will have to be disregarded.

As legs I are more easily modified than legs IV, the latter should furnish modifications of greater phylogenic significance than legs I. The most primitive condition found in legs IV is that in which they resemble legs II and III, that is there are five segments and the tarsus is well developed and the unguis bears two well-developed hooks and an ambulacrum, as found in Pygmodispus. Evolution in this pair of legs has been through reduction. Judging from available figures of species of Pygmodispus the original chaetotaxy, beginning with the femur is 2, 1, 3, 5. In Imparipes the distal (ultimate) segment still has five bristles while the penultimate has three or four. Thus I regard the penultimate as constituting the fused genual and tibia. In his various figures Paoli has a broken line encircling the penultimate segment as if there occurred an indistinct fusion line. He calls this the fourth segment thus evidently recognizing it as a compound segment. Since the fusion is complete and in order not to confuse the student, I will henceforth refer to this leg as four segmented. In Scutacarus and Variatipes the ultimate segment bears seven to eight bristles while the penultimate bears but one or none. Thus it is evident that in these two genera the ultimate segment is the fused tarsus and tibia while the penultimate segment is the genual.

[1]Monografia dei *Tarsonemidi*, Redia, 7:215-281, pls. 7-11, 1911.

These modifications are coincident with the development of parasitism.

I now present a new key to genera beginning with the most primitive:

1. Legs IV with five distinct segments; tarsi IV with two well developed ungual hooks ..... 2.
1. Legs IV with four distinct segments ..... 3.
2. Tarsi I with ungual hook ..... *Pygmodispus*
2. Tarsi I without ungual hook ..... *Diversipes*
3. Tarsi IV bearing five bristles and an attenuated unguis with minute hooks ..... *Imparipes*
3. Tarsi IV bearing seven or eight bristles and no unguis ..... 4.
4. Tarsi I with ungual hook ..... *Scutacarus*
4. Tarsi I without ungual hook ..... *Variatipes*

## **Variatipes pennaticlavarum** sp. nov.

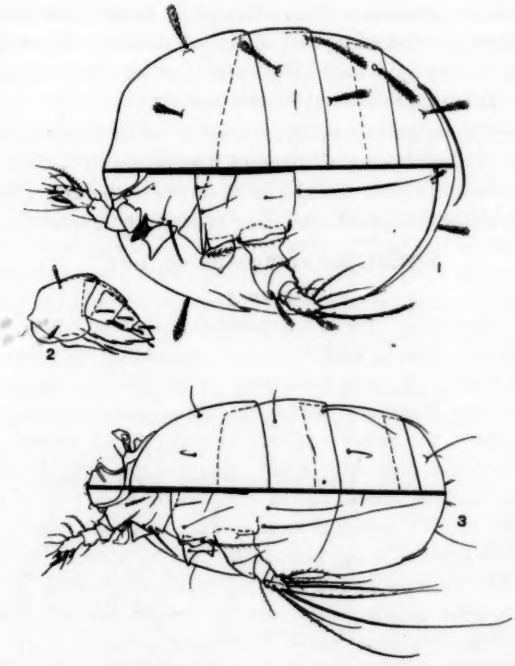
Figures 1 and 2

*Diagnostic characters*: Dorsal bristles large, coarsely ciliate so as to make them clavate (figure 1), the lateral bristles of plates II and III prone and smeared with foreign matter so as to be difficult to discern, lateral bristles of plate IV long, stout, simple and bent close to posterior edge of body (figure 1). These bristles are often gummed together so as to give posterior edge of abdomen the appearance of being double (as figured in lower or ventral half of figure 1).

*Description*: Color tan; size small: length 0.1599 mm., breadth 0.1189 mm. (say 0.16 mm. x 0.12 mm.); anterior end very abrupt (figure 2), anterior edge flaring over cephalon (figures 1 and 2); bristles of dorsal plate I in approximately the same transverse plane. In toto mounts the limits of the transverse plates are difficult to discern. The most conspicuous transverse line is the anterior edge of plate II (shown by a broken line in figure 1), thus the posterior edge of plate I is convex. This is quite evident from figure 2. I mention this because most of the earlier workers have figured it as concave. The same is true in the genus Pygmephorus which I have studied in lateral as well as dorsolateral aspects. The fact that the underlying anterior edge of the plates is more evident than their posterior edge has led some writers to describe more dorsal plates than are actually present. The primitive condition seems to be four bristles per plate. There is also a series of lateral plates (figure 2), and of ventral plates. The posterior edge of these plates is so much attenuated as to make them invisible in toto mounts except along the edges of the animal. In this species, the mesal pair of bristles of plates II to IV tend to be near anterior edge of exposed part of the plates, the lateral bristles (one on each side) near posterior edge.

Pseudostigmatic organs pointed (cross-hatched in figure 1). No differentiation between parasterna I and II discernible; gular bristles simple, of medium length; lateral bristles of parasterna II simple: the anterior of medium length, the posterior longer and spikelike; mesa bristles of parasterna III short, their base usually overlaps parasterna II so that they seem to spring from parasterna II. That is, parasterna III fits *over* parasterna II. The bristles called presternal by Paoli are thus misnamed and misleading. I am calling them mesal (not internal, for all bristles of the body plates are external) and lateral (not external) bristles of parasterna III. Paoli's presternum is of course, fused parasterna I and II, and

the poststernum is parasterna III and IV. Lateral bristle of parasterna III of medium length, axillary bristle long-ciliate, inserted at lateral edge of parasternum and extending posteriad under (in life) face of trochanterofemur (figure 1); mesal bristle (it is the mesal pair which is most active) of parasterna IV, rather short, inserted between coxae IV, axillary bristle rather long, pauciciliate, inserted on a tiny spinelike projection of the parasternum, lateral bristles (the more conservative, localized pair) reaching to posterior edge of abdomen; posterior edge of abdomen with only two pairs of bristles of which the mesal are much the longer, and ciliate like the dorsal bristles. These bristles do not spring from the ventral plate, as figured by earlier authors but from posterior edge of dorsal plates (see figure 2).




*Variatipes pennaticlavarum* sp. nov. Fig. 1. Dorso ventral aspects, legs II and III omitted; ratio x440. Fig. 2. Lateral aspect, legs omitted; lateral and ventral plates indicated by their edges only; ratio x200.

*Variatipes elongatus* sp. nov. Fig. 3. Dorso ventral aspects of an extended specimen, legs II and IIII omitted; ratio x440.

Lateral face of tarsi I with a short, truncate club inserted near distal end of segment, a fairly long club inserted near middle of segment and a fairly long bristle inserted near proximal third of segment, as well as the usual bristles, mesal face with three ciliate bristles at least one of which is fairly long (figure 1). Trochanterofemur IV with a medium long, barbed bristle inserted on anterior edge of distal half of segment; genual IV with a clavate-ciliate bristle of medium length inserted on anterior face and a rather short simple bristle on anterodistal edge; tarsi IV

as long as greatest length of tibia and genual together, with a ciliate-clavate bristle similarly inserted, proximad of this bristle is a uniserially multiciliate bristle of about the same length; posterior edge of tarsi with the four proximal bristles uniserially multiciliate; the two distal bristles pauciciliate at base, the longer one bilaterally multiciliate along distal third.

*Material examined*: Ten specimens from soil of tall-weed old-field, abandoned four years, on Wentz place near Bent Creek Experimental Forest, ten miles southwest of Asheville, N. Car.; taken December 15th, 1934, slide 34F20p5 (*cotypes*). One specimen from same lot, slide 34F20.2. Eleven specimens from soil sample of closely grazed Andropogon pasture, twelve miles southwest of Asheville on Brevard Road; taken October 23rd 1934, slides 34F13A, 34F13ap1, and 34F12V1. Three specimens from litter of isolated short-leaf pine stand in Andropogon pastures of preceding lot; slide 34F10.2S1. Eight specimens from sod sample from Andropogon bald (Glen Bald), Bent Creek Experimental Forest; taken April 17th, 1935, slides 34F31-S1 and -S2.

Resembling *Scutacarus crassisetus simplex* from moss of Florida (Paoli, p. 253, pl. 9, fig. 50) but having a different disposition of dorsal bristles and, if *S. c. simplex* really differs from the species in no other characters than those given by Paoli, in many other characters including absence of hooks of tarsi I.

## **Variatipes elongatus** sp. nov.

Figure 3

*Diagnostic characters*: Body elongate; cephalon and prothorax often extending beyond dorsal plate I; lateral edge of prothorax with two short bristles; bristles of dorsal plate I in same transverse plane; bristles of parasterna IV in approximately the same transverse plane, the lateral pair extending nearly to posterior edge of abdomen, the mesal pair half as long; dorsal bristles simple.

*Description*: Color pale; size small: length 0.176 mm., breadth 0.09 mm.; cephalon with four bristles, lateral carina (stigma of Paoli) quite prominent, extending onto dorsal face of cephalon as a distinct diagonal ridge, prothorax produced laterally as an angular wing, each angle bearing a short bristle; pseudostigmatic organ with short peduncle and tapering head, terminating in a distinct nipple; dorsal plate bristles mostly below medium length, lateral bristle of plate II quite long, prone, seldom visible, conforming with curve of body, mesal pair of plate IV rather long, lateral pair quite short and barely discernible.

Parasterna I and II nearly completely fused; gular bristles fairly long, bilaterally coarsely ciliate, lateral bristles of parasterna I fairly long, weakly ciliate, inserted on a small winglike extension of posterior corner of parasternum; bristles of parasterna II inserted close together at lateral edge of plate, the mesal of medium length, the lateral spinelike and fairly long; mesal pair of bristles of parasterna III of medium length, the lateral quite long, fine, axillary bristle of medium length, simple; bristles of parasterna IV already described, rather fine for their length, axillary as long as mesal pair, sparsely ciliate, inserted rather anteriad on edge of parasterna III under (in life) insertion of legs III, posterior bristles short, straight, closely spaced.

Lateral face of tarsi I with a short proximal club, a long club inserted at

distal third, broadly surpassing segment, a short, truncate club at distal end; mesal face with a pauciciliate proximal bristle, other bristles apparently smooth (not all included in figure 3), distal end of segment with a short, slightly curved, somewhat stout, truncate bristle which may represent a degenerate unguis or hook; tibiae I with a pauciciliate bristle on mesal face and a smooth one on lateral face; coxae IV with usual bristle, simple, of medium length; genuals IV with a fairly long, pauciciliate bristle inserted on lateral edge, tibiae IV with a stout ciliate bristle inserted on mesoventral edge and a fine bristle inserted on dorsolateral edge; tarsi IV as broad as long, only the two proximomesal bristles and the shorter distal bristle ciliate.

*Material examined*: Ten specimens from soil sample from weedy spot of abandoned field, three years in weeds, Wentz place, near Bent Creek Experimental Forest, ten miles southwest of Asheville, N. Car.; taken December 15th, 1934, slide 34F20p5 (*cotypes*). Two specimens from same lot, slides 34F20p6 and 34F2003. Three specimens from soil sample (including Melilotus, a little moss and debris), abandoned field, three years in weeds, Biltmore estate, eight miles south of Asheville on Brevard road; taken November 26th, 1934, slide 34F19. Four specimens from sod sample of closely browsed Andropogon pasture between wooded ridges twelve miles southwest of Asheville on Brevard road; taken October 23rd 1934, slides 34F12A, 34F13A1 and 34F13A2. Seven specimens from sod sample of twelve years old Andropogon pasture, good growth with scattered two to three year old pines, Cook property, nine miles from Asheville on Brevard road; taken February 19th 1935, slide 34F26. Two specimens from sod sample from heavy growth of Andropogon, top of Shut-in-Ridge, Bent Creek Experimental Forest; taken May 8th 1935, slides 34F34-9 and 34F34-11. Twenty-five specimens from sod sample from Andropogon bald (Glen Bald), B. C. E. F.; taken April 17th 1935, slides 34F31-1, -S1, and -S2.

**Scutacarus echidna amicus** subsp. nov.

Differs from the species (Paoli, p. 242, pl. 8, figs. 31 and 32) in that all bristles of dorsal plates II to IV are barbed; all bristles of venter are barbed except possibly mesal pair of poststernals: all bristles of legs IV are barbed to ciliate except the ungual (mesodistal).

*Cotypes*: Fifty specimens from lowest layer of litter of forty year old old-field white pine plantation, Biltmore estate, eight miles from Ashville on Brevard road, N. Car.; taken October 8th 1934, slide 34F9.3P1.

## CAPITOPHORUS APHIDS INFESTING ARTEMISIA[1]

BY G. F. KNOWLTON AND C. F. SMITH[2],
Logan, Utah.

Approximately 75 species of *Artemisia*, or sage, occur in the Rocky Mountain region, many of these being infested by aphids, often to a considerable extent. The great economic importance of several specis of *Artemisia* as food for range livestock and the incomplete knowledge of the aphids attacking them in Utah

1 Contribution from the Entomology Department, Utah Agricultural Experiment Station.
2 Associate Entomologist and Research Assistant, respectively.
Authorized for publication, 14 April, 1936.

led the writers to undertake this study. Most of the report deals with the apterous forms which are most frequently encountered and which possess good specific characters for identification.

KEY TO APTERA

A. Cornicles dark.
  B. Antennae longer than body ..... *quadritrichus* n. sp.
  BB. Antennae shorter than body ..... *pullus.*
AA. Cornicles pale, may be dusky at apical end.
  B. Head bearing 2 kinds of hairs, pointed to blunt, and fan-shaped.
    C. Cornicles distinctly longer than cauda ..... *heterohirsutus.*
    CC. Cornicles equal to or shorter than cauda ..... *bitrichus* n. sp.
  BB. Head bearing fan-shaped to apically widened hairs only.
    C. Cornicles shorter than cauda.
      D. Antennae shorter than the body ..... *infrequenus* n. sp.
      DD. Antennae longer than the body.
        E. Cornicles shorter than hind tarsi ..... *brevinectarius.*
        EE. Cornicles longer than hind tarsi ..... *spatulavillus* n. sp.
    CC. Cornicles longer than cauda.
      D. Antennal III shorter than IV.
        E. Hairs on antennal I and II blunt or pointed..*zoomontanus* n. sp.
        EE. Hairs on antennal I and II fan-shaped ..... *longinectarius.*
      DD. Antennal III longer than antennal IV.
        E. Unguis less than 0.7 mm. long ..... *decampus* n. sp.
        EE. Unguis more than 0.7 mm. long ..... *glandulosus.*

### Capitophorus bitrichus n. sp.

*Apterous vivipara.* Body 1.0 to 1.28 mm. long and covered with numerous flattened hairs, the hairs on the vertex varying from fan-shaped and 0.021 to 0.03 mm. long to pointed; antennal III, 0.2 to 0.24 mm. long and with 1 to 2 sensoria; IV, 0.15 to 0.204; V, 0.15 to 0.204; VI, 0.9 to 0.11+0.29 to 0.36; rostrum reaching third coxae, needle-like tip resembling distinct 5th joint; rostral IV + V, 0.11 to 0.126 mm.; hind tibiae 0.47 to 0.55; hind tarsi 0.11 to 0.13; cornicles cylindrical, subequal to cauda, 0.09 to 0.16 long; cauda 0.11 to 0.167 mm. long.

*Collection.* On *Artemisia* at Bear Canyon, August 12, 1925; Bradshaw Ranch, Sardine Canyon, August 13, 1925; Lewiston, August 4, 1925; Logan, August 14, 1925, in Utah (Knowlton).

*Taxonomy.* This species runs to *C. brevinectarius* G. and P. in Gillette and Palmer's key (Ann. Ent. Soc. Amer. 27:144) from which it differs in being: Smaller, antennal segments being shorter and of lighter color, shorter tibiae and tarsi, and in the hairs on vertex varying from fan-shaped to pointed. It differs from *C. heterohirsutus* G. and P. in having cornicles equal to or shorter than cauda, in the immature forms possessing both pointed and fan-shaped hairs, and in shorter rostral IV + V.

### Capitophorus decampus n. sp.

*Apterous vivipara.* Color bluish to apple green overlaid with a whitish cast; body 1 to 1.5 mm. long, covered with fan-shaped hairs 0.024 to 0.04 mm.

long, 0.04 to 0.053 on vertex; antennae dark beyond middle of V; antennals I and II bearing numerous finger-like to funnel shaped hairs; antennal III, 0.4 to 0.55 mm. long with 1 sensorium; IV, 0.30 to 0.35; V, 0.31 to 0.38; VI, 0.11 to 0.14 + 0.5 to 0.66 mm. long; rostrum surpassing third coxae; rostral IV + V, 0.11 to 0.14 mm. long, apex acute and needle-like; hind tibiae 0.67 to 0.78; hind tarsi 0.09 to 0.125 (equal to or shorter than rostral IV + V); cornicles pale, 0.28 to 0.44; cauda pale 0.15 to 0.204 mm. long.

*Collections.* On *Artemisia tridentata* at Brigham, Collinston, Honeyville, Utah, April 28, 1927 (Knowlton); Logan, October 12, 1927 (Knowlton); on *A. vulgaris,* Blacksmith Fork Canyon, June 10, 1930 (Knowlton).

*Taxonomy.* This species differs from *C. glandulosus* (Kalt.) in possessing a more robust body, shorter unguis (less than 6 times base of VI), rostral IV + V equal to or longer than hind tarsi; unguis noticeably shorter than (or barely equaling) hind tibiae, and less than 1.5 as long as antennal III. *C. decampus* differs from *C. artemisicola* (Wil.) in aptera, possessing only 1 sensorium on antennal III in aptera, cornicles shorter than antennal III, and in antennal V being equal to or longer than IV.

### **Capitophorus glandulosus** (Kalt).

On *Artemisia tridentata* and once on *A. ludovicinae,* in Utah at Brigham, May to August; Collinston, June 19, 1927; Bear River City; Deweyville; Dry Lake; Emigration Canyon, August 16, 1927; Emery; Hyrum; Logan Canyon; Garden City; Laketown; Logan; Heber, July 13, 1927; Honeyville; Hurricane, July 11, 1925; Spring Hollow; Perry; Ogden Canyon; Sardine Canyon; Salt Lake City; Sunset (Knowlton, Smith). Also in Idaho at Franklin, Montpelier, and Fish Haven, August 16, 1927, upon *A. tridentata* (Knowlton); Castleford, September 11, 1932 (D. E. Fox); and Pingree Park, Colorado, August 21, 1935 (Knowlton).

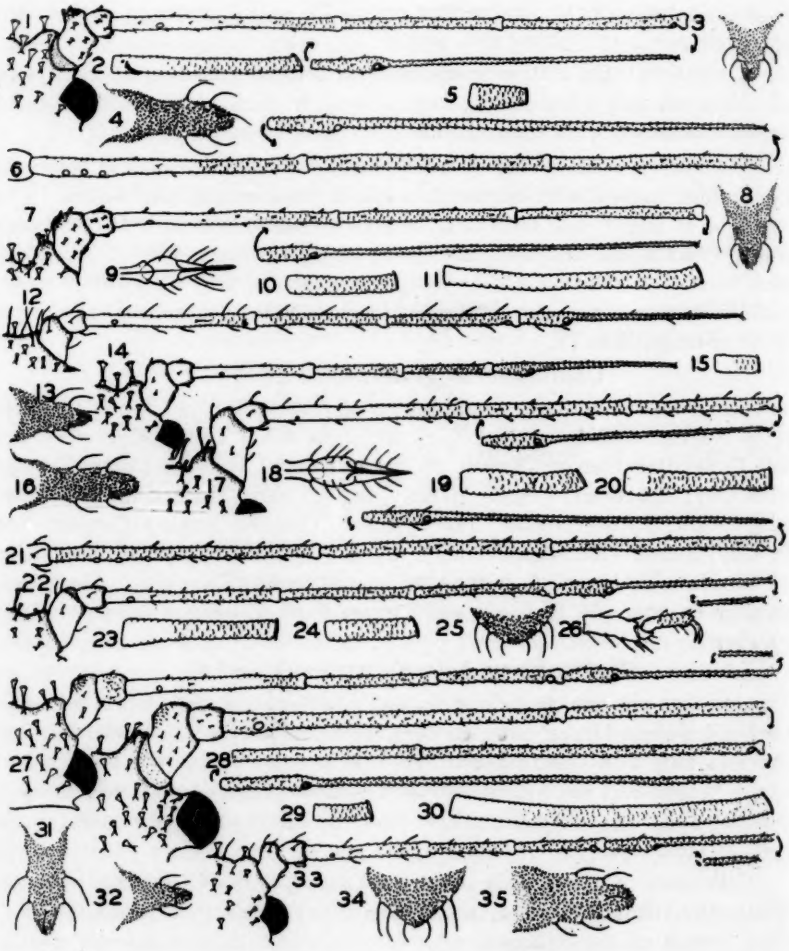
### **Capitophorus heterohirsutus** G. and P.

*Apterous vivipara.* Body 0.97 to 1.22 mm. long and densely covered with pointed to fan-shaped hairs; antennae dark beyond middle of V, antennal III, 0.37 to 0.46 mm. long with 1 to 2 sensoria; IV, 0.26 to 0.32; V, 0.23 to 0.29; VI, 0.09 to 0.11 + 0.39 to 0.43 mm.; rostral IV + V 0.12 to 0.14; hind tibiae 0.67 to 0.82; hind tarsi 0.12 to 0.14; cornicles pale to dusky on apical end, 0.18 to 0.25; cauda pale, 0.14 to 0.16 mm.

*Collections.* On *Artemisia* at Burned Canyon, Carter Creek and Greendale in Uinta Mountains, August 4, 1932 (Knowlton); Bradshaw Ranch, Sardine Canyon, August 13, 1935 (Knowlton). Measurements of Utah material slightly greater than for Colorado material.

### **Capitophorus infrequenus** n. sp.

*Apterous vivipara.* Body 1.4 mm. long and thickly set with flattened to fan-shaped hairs 0.045 to 0.05 mm. long on the vertex and 0.026 to 0.035 on the sides of the abdomen; antennae 1.0 to 1.15 mm. long, pale to dusky beyond middle of IV; antennal III, 0.27 mm.; IV, 0.19; V, 0.19; VI, 0.078 + 0.28 to 0.33 mm.; rostrum attaining second coxae; rostral IV + V acute, tip needlelike, 0.09 to 0.1 mm. long; hind tibiae 0.56; hind tarsi 0.08; cornicles pale, cylindrical with weak




*Capitophorus decampus* n. sp. Aptera, 1-3. *C. brevinectarius* G. and P. Aptera, 4-6. *C. glandulosus* (Kalt.). Aptera, 7-8, 11. *C. heterohirsutus* G. and P. Aptera, 9-10, 12. *C. infrequenus* n. sp. Aptera, 13-15. *C. quadritrichus* n. sp. Aptera, 16-19; alate, 20-21; *C. pullus* G. and P. Aptera, 22-23. *C. spatulavillus* n. sp. Aptera, 24-27, 31. *C. zoomontanus* n. sp. 28, 30 34-35. *C. bitrichus* n. sp. Aptera, 29, 32-33.

flange, 0.06 to 0.08; cauda pale, 0.13 mm. long on median portion, with total length 0.17.

*Collections.* On *Artemisia,* Big Cottonwood Canyon, Utah, August 22, 1935 (Smith).

*Taxonomy.* This species resembles *C. brevinectarius* G. and P., but differs in having: Antennae shorter than the body; shorter appendages; unguis less than 1½ times III; base of VI shorter than rostral IV + V; and cornicles not conspicuously imbricated. It differs from *C. spatulavillus* in: Antennae shorter than body; cornicle subequal to base of VI; shorter hairs on vertex; cornicles less than one-half length of cauda.

**Capitophorus quadritrichus** n. sp.

*Apterous vivipara.* Color blush-green appearing grayish over the body; size 1 to 1.44 mm. long; hairs on vertex 0.06 to 0.07 mm. long and flattened at apical end; antennae longer than body, 1.9 to 2.3 mm. long and dark beyond middle of IV, with III and proximal one-half of IV dusky: antennal III, 0.42 to 0.52 mm. long with 1 or 2 sensoria; IV, 0.36 to 0.47; V, 0.32 to 0.42; VI, 0.11 to 0.14 + 0.47 to 0.62 mm.; rostrum acute, needle-like at tip, surpassing 3d coxae (occasionally reaching second abdominal segment); rostral IV + V 0.13 to 0.16 mm.; legs dark except proximal two-thirds of tibiae which are dusky: hind tibiae 0.84 to 1.4; hind tarsi 0.12 to 0.15; cornicles dusky to dark, 0.22 to 0.4; cauda dark, 0.22 to 0.32, hard portion being 0.17 to 0.25 mm. long with 1 (to 3) dorsal and two pairs of lateral hairs.

*Collections.* Collected in Utah upon *Artemisia tridentata,* Cache Junction, May 17, 1927; Cedar Creek and Curlew Valley, June 9, 1930; Dry Lake, August 10, 1927; Hansel's Mountains and Hardup, June 9, 1927; Honeyville, May 17, 1927; Mona, July 26, 1927; Providence (1 specimen 1.75 mm. long) August 26, 1925; Sardine and Wellsville Canyons, August 10, 1927; Woodruff, July 5, 1925 (Knowlton;) and Logan Canyon, August 21, 1934 (Smith).

*Taxonomy.* This species differs from *C. pullus* G. and P. in color, being green instead of brown, smaller size, antennae distinctly longer than body, rostrum exceeding third coxae, shorter rostral IV + V, shorter cornicles and tarsi, but longer antennae, antennal segments, and cauda, cornicles shorter than antennals IV and V, longer and more prominent hairs on antennae.

*Alate vivipara.* Body 1.72 mm. long and covered with numerous fan-shaped to flattened hairs; hairs on vertex 0.05 to 0.06 mm. long; antennae 2.56 mm. and black beyond basal portion of III; antennal III, 0.58 to 0.6 mm. long with 6 sensoria in a row; IV, 0.5; V, 0.47; VI, 0.13 to 0.14 + 0.74 mm. long; rostrum surpassing 2d coxae; rostral IV + V 0.15 mm. long; hind tibiae 2.07; hind tarsi 0.15; cornicles black, 0.33; cauda dark, 0.28, hard portion 0.22 mm. long, with 2 pairs of lateral and 1 dorsal hairs.

*Collections.* Alates were taken at Blacksmith Fork Canyon, June 9, 1935 (Smith); and Woodruff, July 5, 1935 (Knowlton).

**Capitophorus spatulavillus** n. sp.

*Apterous vivipara.* Pale green, appearing white due to numerous fan-shaped hairs; hairs on vertex 0.05 to 0.07 mm. long, usually shorter on body; antennae pale to dusky beyond middle of V, and 1.6 to 1.9 mm. long; antennal III,

0.28 to 0.42 mm. long, bearing 1 oval sensorium; IV, 0.25 to 0.37; V, 0.23 to 0.29; VI, 0.1 to 0.13 + 0.4 to 0.6 mm.; rostrum surpassing second coxae, rostral IV + V 0.11 to 0.13 mm. long and acutely conical, tip needle-like; hind tibiae 0.66 to 1; hind tarsi 0.1 to 0.14; cornicles pale to slightly dusky, 0.13 to 0.26 long with weak flange straight or at an angle; cauda 0.21 to 0.26 mm. long.

*Collections.* On *Artemisia* in Utah at Ash Creek, Washington County, April 25, 1935 (Knowlton-Smith); Dry Lake, August 10, 1927 (Knowlton). On *A. tridentata* at Minkcreek, Idaho, August 16, 1927 (Knowlton).

*Taxonomy.* This species runs to *C. brevinectarius* in Gillette and Palmer's key (Ann. Ent. Soc. Amer. 27:144), from which it differs in: Cornicles longer than hind tarsi; cornicles more than half the length of the cauda; paler antennae and shorter antennal segments; only 1 sensorium upon antenna! III. It differs from *C. heterohirsutus* in having only fan-shaped hairs upon head; cornicles shorter than cauda.

**Capitophorus zoomontanus** n. sp.

*Apterous vivipara.* Color grayish-green; body rather slender, 1.9 to 2.3 mm. long; body with numerous fan-shaped hairs; hairs on vertex 0.04 to 0.05 mm. long; antennae dusky beyond middle of IV; antennal III, 0.75 to 0.81 mm. long, with 1 to 2 rounded sensoria; IV, 0.86 to 0.97; V, 0.76 to 0.8; VI, 0.2 to 0.24 + 1.03 to 1.3 mm. long; rostrum surpassing second coxae; rostral IV + V acute, tip needle-like, 0.09 to 0.11 mm. long; hind tibiae 1.4 to 1.8; hind tarsi 0.15 to 0.19; cornicles pale, rather cylindrical, 0.61 to 0.77; cauda pale, 0.26 to 0.32 mm. long.

*Collections.* On *Artemesia* at a 7600-foot elevation in Daniels Canyon, Utah, July 13, 1927, and at summit of this canyon August 16, 1935 (Knowlton).

*Taxonomy.* This species closely resembles *C. longinectarius* G. and P., from which it differs in having short, inconspicuous hairs on antennals I and II; rostral IV + V shorter than hind tarsi; more cylindrical cornicles, which usually are shorter than antennal V.

Types in the collection of the senior author. Paratypes of most species in the U. S. National Museum and the collection of the junior author.

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## THE SIGNIFICANCE OF THE OUTGROWTHS ON THE PROTHORAX OF ECDYONURUS VENOSUS FABR. (EPHEMEROPTERA).

BY F. P. IDE,
University of Toronto.

In 1930 Dr. R. H. Emslie turned over to the author a small collection of mayfly nymphs collected by him in streams in Scotland. Among them was a small series of nymphs of *Ecdyonurus venosus* Fabricius in different instars collected at Tummel Bridge and Bridge of Weir. This species is unique in having prominent postero-lateral extensions of the prothorax resembling the wing-pads of the meso- and metathorax (Figs. 1 & 8).

Vayssiere (1882) has described the anatomy of this nymph in detail under the name *Heptagenia longicauda* and refers to these structures as prolongations. Enough material was included in Dr. Emslie's collection to show that these prothoracic processes grow back in much the same manner as the wing

pads to a certain point but never develop into wings and are not represented in the adult, except possibly by the thin posterior flange of the segment.

The growth of the mesothoracic wing-pads of *Heptagenia pulla* Clem., a similar type of nymph found in America, has been studied. The lengths of the wing pads of about two hundred and fifty individuals of the last seven instars were measured. To compensate for differences in size of nymphs the length obtained for the wing-pads was divided by the length of the seventh abdominal segment for each individual. The factors (length of mesothoracic wing-pad by length of seventh abdominal tergum) thus obtained were plotted in a frequency diagram from which the mode of the factor for each instar was determined.

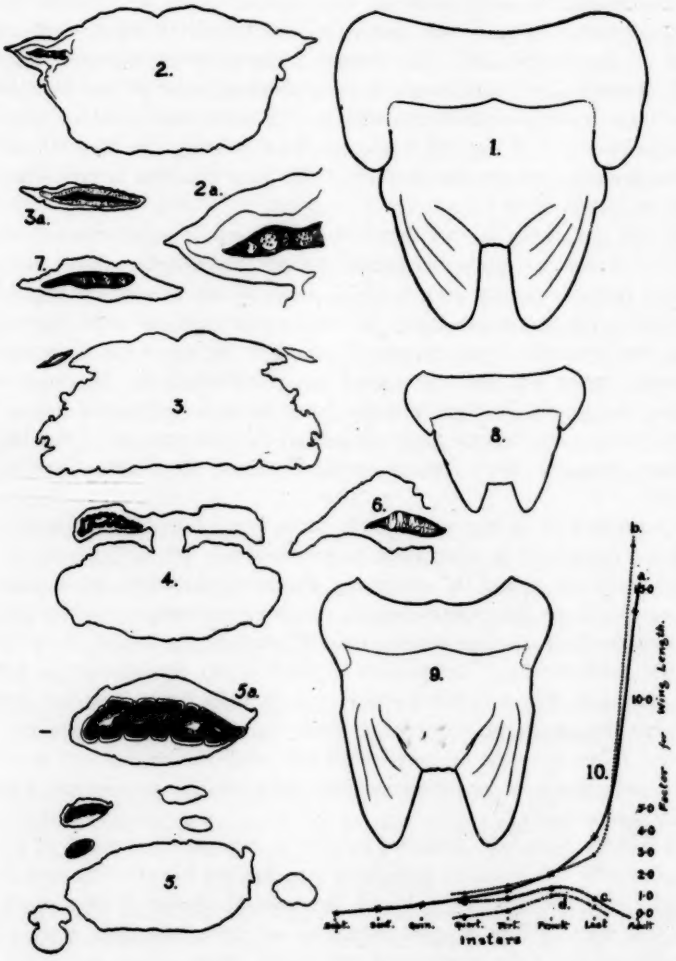
The line "a" of Fig. 10 is the result of plotting the factors, determined as described above, against the number of the corresponding instar including also the imago.

In the graph the interval between each instar is equal since the duration of each instar was not known. Line "b" of the same figure shows the plotting of similar factors for the instars of *E. venosus* represented in the collection. The points in this curve are based on the measurement of a few nymphs only and therefore probably do not represent accurately the mode for the instars. The last nymphal instar was not represented in the collection but the point has been included on the graph, the measurements being taken from Eaton's figure (1888). The point on the curve for the adult is based on the measurement of one individual. Both these curves, in their upward swing, illustrate the relative growth of the wing-pads.

Measurements of the prothoracic extensions treated in the same way as those of the mesothoracic wing pads to give a factor for each instar are shown graphically in lines "c" and "d" of fig. 10. The measurements used in plotting line "c" were made from the posterior border of the prothorax to the tip of the extension whereas those used in plotting line "d" were of the length of the free portion of the process only. The process is fused to the mesothorax as far as the point X shown in Fig. 1, beyond which it is entirely free. Both of these lines indicate that the prothoracic extensions grow out in much the same way as the wing-pads. They grow at an accelerated rate until the second last instar when there is a retardment in growth rate, they drop behind, and in the adult have practically disappeared.

In figures 2 to 5 are illustrated transverse sections of a nymph of the penultimate instar which is about to transform into the last instar. The cuticle of the meso- and methathoracic wing pads of the enclosed nymph is very much folded showing that there will be a great expansion of these structures at ecdysis. In contrast the cuticle of the prothoracic extensions (Figs. 3 and 3a) is not folded in a like manner and this is what one would expect from the appearance of these structures in the last instar. The graphs "c" and "d," Fig. 10, show that the growth increment of these extensions is practically nothing between the penultimate and last instars.

It was hoped that a nymph of the third last (tertiult) instar would be found which was about to shed its skin, but such a nymph was not available in the limited amount of material at my disposal. One would expect that the pro-




ECDYONURUS VENOSUS FABR.

thoracic extensions of the enclosed penultimate instar would be much folded since it is between the tertiult and penultimate instars that these structures increase at the maximum rate. Sections of an early tertiult nymph (Figs. 6 and 7) show that the hypodermal cells in the prothoracic extensions are of a similar type to those in the meso- and metathoracic wing pads with this difference, that they are much less crowded together.

Handlisch (1908) figures in his atlas five insects of the carboniferous order Palaeodictyoptera which have prominent lateral prothoracic extensions. These five insects belong to five different families of the order so that these structures were of wide occurrence. They are thought to be the homologues of wings and to represent an antecedent condition in the evolution of wings in which they were not moveable and functioned as gliders. The fact that these processes are lateral in Palaeodictyoptera is not disturbing since nymphs of members of the same order show the meso- and metathoracic wing pads also projecting laterally. They are thought by Comstock (1918) to have been terrestrial nymphs on this account.

In the nymphs of Ephemeroptera and Protephemeroptera the meso-and metathoracic wing-pads project backwards and the prothoracic extensions also project backward and are distinct from the flange which frequently borders the lateral margins of the pronotum.

There has been no data available on the growth of the prothoracic extensions in Palaeodictyopteran insects. For this reason it seemed desirable to describe in this paper the growth of similar wing-like prothoracic lobes of Ephemerid nymphs as an additional point in support of the theory that they are homologous with wings and not special nymphal structures. The fact that they do not persist in the adult does not rule out the possibility of their being a recapitulation of an adult structure in an ancestral type. There is a parallel to this phenomenon in the disappearance of the median caudal filament in the adults of many mayflies. Frequently the adult will have no or a very reduced median filament whereas the nymph of the same species will have a median filament as well developed as the lateral filaments. Within the order Ephemeroptera the three tailed condition is probably primitive since it is so universal a characteristic of the families in the group and is found in the Protephemeroptera.

The question might be raised as to whether the family Heptageniidae to which *E. venosus* belongs is a primitive group within the order. Spieth (1933) in his discussion of the phylogeny of Ephemeroptera places the family Heptageniidae in what he considers the most primitive superfamily, namely the Siphlonuroidea. The family Siphlonuridae in his arrangement is, however, more primitive than the Heptageniidae within the superfamily.

It seems probable that the extensions of the prothorax in *E. venosus* are homologous with wing-pads and that they are governed by the same growth centre as that controlling the growth of the mesothoracic and metathoracic wings. The growth compartment, to use Huxley's term (1931), is not as restricted in this form as in the other species of mayflies and affects the prothorax also as it did apparently in some of the Palaeodictyoptera.

In most members of the family Heptageniidae to which *E. venosus* belongs the prothorax of the nymph is intimately fused to the mesothoraxx at the sides

but becomes free again in the adult condition. This fusion is illustrated in Fig. 9 of the pro- and mesothorax of *Heptagenia pulla* Clem. It is possible that this is a fusion of the prothoracic processes to the sides of the mesothorax.

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## Explanation of Plate 13

Figures 1-5, penultimate nymphal instar of *E. venosus;* 1. Prothorax and mesothorax; 2. transverse section through prothorax; 2a. enlarged lateral border; 3. transverse section through mesothorax showing posterior extensions of prothorax; 3a. enlarged prothoracic extension; 4. transverse section through posterior portion of mesothorax showing bases of mesothoracic wing-pads; 5. transverse section behind thorax showing meso-and metathoracic wing-pads; 5a. enlargement of mesothoracic wing-pad; 6. enlargement of transverse section of prothoracic extension of tertiult instar of E. *venosus*; 7. transverse section of metathoracic wing-pad of tertiult instar; 8. pro- and mesothorax of a young nymph of *E. venosus* showing an early stage in the development of the prothoracic extensions; 9 pro- and mesothorax of a nymph of *Heptagenia pulla* showing fusion of the prothorax to the mesothorax at the sides; 10. graph showing growth of wings during the later nymphal instars and adult of *H. pulla* and *E. venosus;* 10a. mesothoracic wings of *H. pulla;* 10b. mesothoracic wings of *E. venosus;* 10c. prothoracic extensions of *E. venosus* measured from the posterior border of the prothorax; 10d. the free portion (point X to apex) of the prothoracic extensions.

## ANNUAL MEETING ENTOMOLOGICAL SOCIETY OF ONTARIO

The Seventy-third Annual Meeting of the Entomological Society of Ontario will be held at the Dominion Parasite Laboratory, Dundas St. E., Belleville, on Thursday and Friday, November the 19th and 20th, 1936.

A meeting of the council will be held on Wednesday evening, November 18th, at 8.15, in the Dominion Parasite Laboratory.

Titles of papers should be in the hands of the Secretary by November 1st. The presentation of a paper during the general meeting should not exceed 15 minutes. This limit does not apply to the manuscript. Please advise of time required for the presentation of your paper and whether a lantern is required.

L. S. McLAINE, President. R. H. OZBURN, Secretary.

A. B. BAIRD, Chairman of the local committee.

Mailed Saturday, October 31st, 1936.

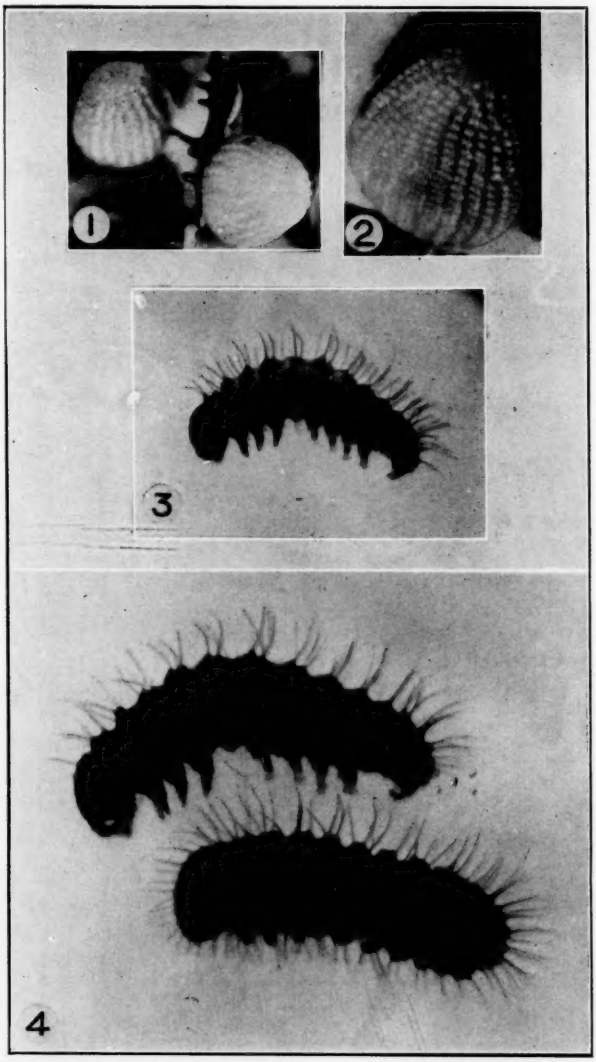


Fig. 1. Ovum of *B. montinus* Scud. x 25. 2. Same, x 50. 3. Larva, 1st instar, *B. montinus* x 35. 4. Same, dorsal and lateral views x 50. Photographed in alcohol.